

CA20N
EV 530
1973
L11

REPORT ON A WATER POLLUTION SURVEY

Laurel Creek
City of Waterloo
Regional Municipality
of Waterloo

1973



Ontario

Ministry
of the
Environment

The Honourable
William G. Newman,
Minister

Everett Biggs,
Deputy Minister

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact ServiceOntario Publications at copyright@ontario.ca

REPORT
ON A
WATER POLLUTION SURVEY
OF
LAUREL CREEK
CITY OF WATERLOO
REGIONAL MUNICIPALITY
OF WATERLOO

1973

Regional Engineers Section
Sanitary Engineering Branch

*From Environment
for 210
Sanitary Eng. Sect*



Ontario

Ministry of the
Environment

135 St. Clair Avenue West

Suite 100

Toronto Ontario

M4V 1P5

Regional Municipality of Waterloo,
Marsland Centre,
WATERLOO, Ontario. N2J 4G7

Attention Mr. A. W. Woods, Clerk.

Dear Sir:

Re: Regional Municipality of Waterloo
Laurel Creek Survey.

We are forwarding to you, under cover of this letter, our "Water Pollution Survey of Laurel Creek 1973". Additional copies have been provided for distribution to Council.

The report concludes that pollution of Laurel Creek, both from industrial and domestic sources, is occurring from various storm sewers within the City of Waterloo and the community of Bridgeport.

The recommendations presented in the report are made with the realization that the region is presently conducting surveys of the various industries located in the boundaries of Laurel Creek and it is hoped that the problems described in this report will be of aid in this programme and that the servicing of Bridgeport with sanitary sewers will not be unduly delayed.

We trust that the Council will find this study of value and that some early action may be taken to implement the report recommendations.

Yours truly,

R. J. Hopkins, P.Eng.,
Regional Engineer,
Sanitary Engineering Branch.

WBP:bb

encl.

REPORT

MINISTRY OF THE ENVIRONMENT

1.0 INTRODUCTION

Studies over the years have been carried out on Laurel Creek to determine the quality of the water in the creek and the quality of discharges to the creek whether by means of small tributaries or storm sewer discharges.

These studies were conducted in 1966, 1971, with the most recent being completed in 1973. The pollution surveys of Laurel Creek were conducted in the areas of high population density and industrial development as these are usually considered to be the major problem areas.

This report is a summary of the data obtained to date on Laurel Creek with a discussion on the water quality of the creek and recommendations aimed at restoring it to acceptable levels.

2.0 SUMMARY

The water quality of Laurel Creek varies extremely as it flows through the urban centres of the City of Waterloo and the Village of Bridgeport. In Waterloo both industrial and domestic wastes are being discharged to the creek via storm sewers. Analyses of the samples from the creek itself indicate that some assimilation or dilution of the wastes occurs in the 2.8 miles from Marshall Street in Waterloo to Mill Street in Bridgeport where populations are not dense. Malfunctioning septic tanks and discharges from sewers in Bridgeport significantly impair the quality of the creek before it flows into the Grand River.

3.0 DESCRIPTION OF LAUREL CREEK

3.1 Location

Laurel Creek is a tributary of the Grand River which originates in a forested region of swampland and marshes in the south-eastern section of Wellesley Township. The creek meanders south-easterly through the Township of Woolwich and the City of Waterloo and enters the Grand River approximately 200 feet east of Bridge Street in the community of Bridgeport.

3.2 Streamflows

A streamflow measuring station operated by Environment Canada is located on Laurel Creek 25 feet downstream of Weber Street in Waterloo and covers a drainage area of 23 square miles. Continuous records of streamflow for Laurel Creek date from June 1959 and summary of the flows is contained in Table 1 on the following page.

The Laurel Creek Reservoir, which is located on Bearinger Road, is a shallow 250 acre lake owned and operated by the Grand River Conservation Authority. The Reservoir was constructed and filled in the spring of 1967 to provide some moderation of flows in Laurel Creek.

Streamflow data from January 1973 to December 1973 indicates an average flow of 25.0 c.f.s. Extremes recorded show a maximum instantaneous discharge of 1590 c.f.s. at 5:50 p.m. on February 10, 1965, with three zero discharges being recorded in the years 1962, 1963 and 1966. Since the construction of the dam, there has been no time that a zero discharge has occurred.

TABLE 1 LAUREL CREEK
SUMMARY OF STREAMFLOW 1960 TO 1972

<u>Date</u>	<u>Mean Discharge (CFS)</u>	<u>Total Discharge (Ac-Ft)</u>	<u>Maximum Daily Discharge (CFS)</u>	<u>Minimum Daily Discharge (CFS)</u>	<u>Maximum Instantaneous Discharge (CFS)</u>
1960	17.4	12600	308 Mar. 31	0.40 Jul. 9	480 at 2200 EST Mar. 30
1961	12.5	9020	265 Feb. 23	0.40 Sept. 29	634 at 0900 EST Feb. 23
1962	11.0	7960	124 Mar. 25	0 May 27	359 at 1300 EST June 10
1963	10.7	7720	340 Mar. 25	0 Jul. 7	495 at 2000 EST Mar. 25
1964	12.4	9010	156 Dec. 25	0.10 Oct. 4	618 at 0520 EST Aug. 3
1965	24.7	17900	616 Feb. 10	0.20 June 25	1590 at 1750 EST Feb. 10
1966	13.6	9840	207 Dec. 7	0 Oct. 3	232 at 1950 EST Dec. 7
1967	22.3	16200	453 Apr. 3	0.60 Oct. 5	1050 at 0140 EST Apr. 3
1968	19.5	14100	485 Aug. 6	0.70 Apr. 3	1310 at 0315 EST Aug. 6
1969	17.1	12400	166 Jan. 30	1.2 Aug. 14	272 at 1805 EST Jan. 30
1970	15.5	11200	75.2 Apr. 9	0.94 June 14	275 at 1505 EST Aug. 12
1971 *	22.0	6580	204 Apr. 2	2.1 May 23	257 at 0300 EST Apr. 2
1972	21.1	15300	233 Apr. 13	2.3 Sep. 21	474 at 1201 EST June 21

* Jan. - May only

LAUREL CREEK HISTORICAL STREAM FLOW SUMMARY

ENVIRONMENT CANADA

3.3 Water Use

The main water use of Laurel Creek is for recreational purposes with two parks being developed adjacent to the creek by the City of Waterloo. The creek also meanders through the University of Waterloo's property adding to the aesthetics of this property.

As previously mentioned, the Grand River Conservation Authority maintains the Laurel Creek Reservoir for flood control, however, as with the majority of these projects, the land surrounding the reservoir is extensively used for recreational purposes.

4.0 PREVIOUS REPORTS

In 1966, a report entitled "Water Resources Survey of the County of Waterloo" prepared by the Ontario Water Resources Commission, made brief mention of Laurel Creek.

It was found that the majority of the storm sewer outlets to Laurel Creek had insufficient flow for sampling purposes, however, the storm sewer outlet at Herbert Street indicated the presence of domestic sewage. The report goes on to say that the water quality of Laurel Creek downstream from the City of Waterloo was satisfactory with a small degree of pollution being noted in Bridgeport at the confluence of the creek with the Grand River.

Two pollution surveys were carried out in the community of Bridgeport. The first survey was in 1961 with the second being completed in 1962. Both of these reports were published and indicated that pollution from Bridgeport was reaching Laurel Creek. The above two reports were briefly updated in 1972 and although this survey was not published, it confirmed the previous findings.

Searching

Titles and Keywords

Editorial 5610438 not rep printed monogra ISBD A2 abbrev verified

Summary of Records : No. 1

NAMES:

cor,pl v en altern Ontario.\$bSanitary Engineering Branch.\$bRegion
al Engineers Section

TITLES:

descrip v en0 ^AE ME,ts Report on a water pollution survey of Laurel C
reek, City of Waterloo, Regional Municipality of
Waterloo

SUBJECTS:

topical v e LCSH Water\$xPollution\$zOntario\$zLaurel Creek
geograp v e LCSH Laurel Creek (Ont.)

NOTES:

cat src Ca00N\$beng\$cCa00N
collatn 11, [9] leaves :\$bmap ;\$c30 cm.
geo area n-cn-on

Enter code from below

t new term f forward k locations s summary

x file transfer

i new file j complete

g brief ? help

w show file m misc

e end

*transferred
and filed*

Searching

Titles and Keywords

Editorial 5610438 not rep printed monogra ISBD A2 abbrev verified

Summary of Records : No. 1

NOTES (cont.):

geo area n-cn-on

pub pre [Toronto] :#bRegional Engineers Section, Sanit
ary Engineering Branch,#c1973.

general One folded map in pocket.

Enter code from below

t new term k locations s summary

x file transfer

i new file b backwrd j complete

g brief ? help

w show file m misc

e end

5.0 SURVEY PROCEDURES

5.1 Sampling Points

During the 1971 survey, forty-three locations were sampled while during the 1973 survey only twenty-nine of these locations were sampled due to low flow conditions at the remaining locations. Four new locations were added during the 1973 survey bringing the total number of 1973 sampling locations to thirty-three.

The sampling locations are listed in Table I of Appendix I and are marked on the accompanying map.

5.2 Analyses Performed

Two parameters were used for the bacteriological samples obtained, these being Total Coliform Organisms and the Fecal Coliform Organisms and a total of ten parameters were used for the chemical analyses.

All bacteriological and chemical analyses were carried out at the Ministry of Environment Laboratories in Toronto.

It should be noted that not all the bacteriological or chemical tests were carried out on every sample.

An explanation of the significance of the tests can be found in Appendix II.

6.0 RESULTS

6.1 Survey Results

Results of the 1971 and 1973 surveys can be found in Table I of Appendix I and a map showing these location points is also provided.

6.2 Other Data Sources

A summary of results obtained on Laurel Creek from previous reports and this Ministry's monitoring station located in Bridgeport can be found in Table II of Appendix I.

7.0 DISCUSSION OF RESULTS

7.1 Objectives

In assessing the significance of the results, the following objectives for surface water quality are used by the Ministry:

Bacteriological

Total Coliform Organisms	2400/100 ml.
Fecal Coliform Organisms	100/100 ml.

Chemical

5 day Biochemical Oxygen Demand (BOD) -	outfall	15 ppm.
	stream	4 ppm.
Suspended Solids -	outfall	15 ppm.
	stream	4 ppm.
Linear Alkyl Sulphonate (LAS)		0.5 ppm.
Phenols		1 ppb.

The remaining analyses conducted on the samples, although not specified in the Ministry's objectives, are used in conjunction with the above parameters to provide a more detailed picture of specific areas.

7.2 Storm Sewers

Bacteriological

Of twenty-six storm sewer locations, eighteen were found to have discharges containing Coliform Organisms levels above this Ministry's objective of 2400 coliforms per 100 ml. in either 1971 or 1973. At these eighteen locations, the coliform counts ranged from 3,100 to 33,000,000 organisms/100 ml.

Chemical

The Biochemical Oxygen Demand (BOD) and Suspended Solids levels at seven and six locations respectively, exceeded this Ministry's objective of 15 ppm. for BOD and 15 ppm. for suspended solids in either 1971 or 1973.

Three locations were noted to have LAS levels above the acceptable level of 0.5 ppm. while four locations indicated phenol levels above the acceptable level of 1 ppb.

Observations made during the 1971 and 1973 surveys indicated that a variety of wastes other than of a domestic nature were gaining access to Laurel Creek. At sample location GL-116.8(W) located across from the Campus Centre of the University of Waterloo, a white precipitate was observed at this outfall both in 1971 and 1973. The main constituents were identified as Silica and Calcium Carbonate with secondary constituents of Magnesium Carbonate, Aluminum Oxide and Iron. These chemicals are normally associated with boiler operations. A week previous to the October 16, 1973 survey, a fish kill occurred in the vicinity of this location.

Sample location GL-115.1(W) located between the railway bridges north of Erb Street, indicated the presence of Phenols during both the 1971 and 1973 surveys.

During the 1971 survey, the discharge from sample location GL-114.6(W) at Herbert Street, contained a reddish-brown precipitate identified at the laboratories as iron oxide and chromium. Phenols were also found to be present. These constituents have been known to result from plating operations. Although the above chemicals were not identified during the 1973 survey, the presence of domestic waste, as noted in 1971, was indicated.

Although not as great in 1973 as in 1971, effluent from sampling location GL-114.1(W) located at the northwest corner of Tower's Shopping Plaza, had a strong gasoline odour with phenol concentrations being 4000 ppb. and 100 ppb. in 1971 and 20 ppb. in 1973. The presence of domestic waste was also identified.

In 1971, at sample location GL-113.9(W) located at the southeast corner of the bridge at Weber Street, the sample obtained on June 24 was characteristic of domestic sewage. On re-sampling this outfall on July 21, an increase in flow was observed at approximately 12:45 p.m. The effluent was white with an odour characteristic of some detergents or disinfectants. A decrease in flow was noted to occur after approximately thirty minutes, but at 1:30 p.m., flow increased substantially again. A quantitative examination at the laboratories has identified the main constituent to be Aluminum Silicate. The routine analyses indicated the presence of domestic sewage and phenolic compounds. This outfall was dry during the 1973 survey.

As mentioned elsewhere in this report, evidence of septic tank malfunctioning in the community of Bridgeport was noted during both the 1971 and 1973 surveys.

Table III of Appendix I contains a list of the outfalls whose effluents indicated the presence of waste discharges to Laurel Creek.

7.3 Laurel Creek

Laurel Creek and its tributaries were sampled at twenty locations. The locations along with the results are contained in Table I, Appendix I and are indicated on the accompanying map.

8.0 GENERAL DISCUSSION

As can be seen from the results, pollution from various storm sewers along the reaches of Laurel Creek is occurring.

In discussions with Mr. R. Luhowy, Supervisor, Regional Pollution Control Laboratory, he advised that the Region of Waterloo has implemented an industrial waste survey in the City of Waterloo with investigation of seven or eight of the larger industries and some of the smaller industries already being completed. Mr. Luhowy advised that to date, it has been their experience that the industries to a great extent have not been discharging polluting wastes to the storm sewers.

The results contained in this report were discussed with Mr. Luhowy and it was agreed that the locations indicating industrial waste discharges should receive priority, with investigation into the locations indicating domestic waste discharges being incorporated in the Region's routine work.

In conjunction with this, it was determined from the City of Waterloo, Engineering Department, that all of the sewers in the City are separate with there being no combined sewers or bypass facilities in the sanitary sewer systems except at the one pumping station. It was further discussed that sample locations in 1971, which exhibited pollution but were found to be dry during the 1973 survey, should be periodically checked and samples obtained if flows are noted.

The results confirm the presence of pollution in Bridgeport from faulty septic tank systems and the recommendations presented in previous reports that sanitary sewers be installed to service Bridgeport should remain unchanged. It should be noted that a Provincial Sewage Works Programme is under development which will correct the existing problem when constructed.

9.0 RECOMMENDATIONS

It is recommended that:

- (1) Sample locations indicating industrial waste discharges be inspected by the Region to determine the source of the pollution and to eliminate the discharges.
- (2) Sanitary sewers be provided for Bridgeport.
- (3) Sample locations indicating domestic waste discharges be incorporated into the Region's routine monitoring and correction programme.

(4) Sample locations indicating drastically different levels of pollution during either the 1971 or 1973 survey be re-sampled periodically to confirm or deny the presence of pollution.

(5) Sample locations which were found to be dry during the 1973 survey but indicated pollution during the 1971 survey, be periodically inspected.

Prepared by:-



W. B. Pett
Sanitary Engineering Branch
Cambridge District Office

APPENDIX

I

LAUREL CREEK - WATER POLLUTION SURVEY 1971 & 1973

Samples - June, July 1971
October 1973

No.	Date	Sampling Point	Description of Location	Fecal Coliforms Per 100 ML	Coliform Bacteria Per 100 ML	5 Day B.O.D.	Susp. Solids	Nitrogen as N				Phosphorus as P		MBAS as LAS	Phenols in ppb
								Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.		
1A	Oct.16		Outlet of Columbia Lake	10	200	3.5	10	.07	1.2	.006	.18	.086	.004	-	-
1	Jun.9	GL-117.9 W	Outfall appr. 12"Ø concrete into Laurel Cr. west end of University of Waterloo Village Residence II	L-10	20	0.8	5		0.22			0.010			-
	Oct.16			L-10	260	1.0	0	.01	.14	.007	11.	.003	.003	-	-
2	Jun.9	GL-117.7 W	Outfall with appr. 2'x2' bar screen & concrete apron into Laurel Cr. S.W. end of Univ. of Wat. Vill. Res. I	L-10	30	3.0	5		0.26			0.036			-
3	Jun.9	GL-117.4	Outfall appr. 2'Ø with bar screen, concrete apron, & rip-rap ditch to Laurel Cr. S.E. end of Univ. of Wat. Village Residence I	540	6,300	8.0	5		0.32			0.13			-
	Oct.16	W		L-10	1,290	1.4	5	.01	.26	.11	3.4	.96	.92	0.1	-
4	Jun.9	GL-116.8 W	Outfall oval shaped with concrete apron & concrete ditch to Laurel Cr. across from Univ. of Wat. Campus Centre	L-10	L-10	0.6	5		0.34			1.1			-
	Oct.16			L-10	1,840	2.0	0	.02	.68	.054	1.7	.22	.016	-	-
5	Jul.22	GI-116.5	Laurel Cr. at South side of University Ave. bridge off Westmount Rd. north.	1,900	118,000	5.0	150		0.9			0.28			-
	Oct.16			L-10	330	3.0	5	.05	1.1	.080	.37	.085	.010	-	-
6	Jul.22	GLT-116.5	Tributary of Laurel Cr. sampled appr. 10' downstream of Westmount Rd. bridge north of Centennial Rd. vehicle entrance	3,300	103,000	4.5	1030		1.3			0.95			-
	Oct.16			L-10	590	1.2	0	>.01	.31	.010	.87	.017	.003	-	-
7	Jul.22	GLT-116.4 W	Outfall appr. 36"Ø encased concrete into a tributary of Laurel Cr. east of Westmount Rd. bridge	20	35,000	4.5	40		0.6			0.16			-

TABLE 1 - CONT'D

Samples - June, July 1971
October 1973

LAUREL CREEK - WATER POLLUTION SURVEY 1971 & 1973

No.	Date	Sampling Point	Description of Location	Fecal Coliforms Per 100 ML	Coliform Bacteria Per 100 ML	5 Day B.O.D.	Susp. Solids	Nitrogen as N				Phosphorus as P		MBAS as LAS	Phenols in ppb
								Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.		
8	Jul.22	GL-116.2	Laurel Creek above Centennial Park Dam at Band Shell	3,000	125,000	4.0	110		1.3			0.3			-
	Oct.16			40	61,500	3.0	10	.09	1.2	.082	.40	.099	.017	-	-
9	Jul.22	GL-116.2 W	Outfall appr. 6'x3' Ø oval corrugated steel into Laurel Cr. below Centennial Park Dam	2,700	103,000	-	-		-			-			-
10	Jul.22	GL-115.8 W	Outfall from Seagram Dr. & Seagram Stadium parking lot to Laurel Cr. beside foot-path into Centennial Park	600	135,000	5.0	80		1.0			0.25			-
	Oct.16			L-10	500	0.6	5	.01	.13	.003	3.6	.005	.001	-	-
11	Jul.22	GL-115.7	Laurel Creek at Sandbag Dam behind Waterloo Park Zoo west side of railway tracks	4,000	400,000	5.0	140		1.5			0.35			-
12	Jul.22	GL-115.4	North bank of Silver Lake directly behind Park Swimming Pool	5,800	17,700	4.0	15		0.7			0.08			-

TABLE 1 - CONT'D

Samples - June, July 1971
October 1973

LAUREL CREEK - WATER POLLUTION SURVEY 1971 & 1973

No.	Date	Sampling Point	Description of Location	Fecal Coliforms Per 100 ML	Coliform Bacteria Per 100 ML	5 Day B.O.D.	Susp. Solids	Nitrogen as N				Phosphorus as P		MBAS as LAS	Phenols in ppb
								Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.		
13	Jul.22	GL-115.3	Silver Lake at North-west corner of Waterloo Arena parking lot.	3,200	19,800	4.5	15		0.85			0.1			-
14	Jul.22	GL-115.2 W	Outfall appr. 28"Ø concrete to Laurel Creek east bank below dam at Arena entrance.	600	30,000	8.0	15		1.3			0.15			-
	Oct.17			L-100	15,000	14.	15	.05	1.4	.025	.16	.20	.007	-	-
15	Jul.22	GL-115.2	Laurel Creek sampled appr. 50' below Silver Lake Dam.	60	13,500	5.0	15		1.1			0.14			-
	Oct.17			180	880	3.5	10	.08	1.1	.017	.02	.074	.003	-	-
16	Jul.22	GL-115.1 W	Outfall from Sunshine Ave. storm sewers south of Arena parking lot to Laurel Creek.	L-10	400	0.4	5		0.45			0.01			0
	Oct.17			L-1000	1,500,000	11	15	.22	1.7	.008	.23	.34	.035	0.9	-
17	Jul.22	GL-115.1 W	Outfall appr. 24"Ø corrugated steel between railway bridges to Laurel Creek.	L-10	19,100	2.0	5		0.26			0.024			4
	Oct.17			L-10	800	13	5	.01	.43	.015	.15	.039	.003	0.1	8
18	Jul.22	GL-115.0	Laurel Creek sampled at the north side of the bridge at Erb St. West.	70	9,800	4.0	15		1.9			0.17			-
	Oct.17			50	5,600	6.0	10	.07	1.1	.012	.08	.13	.006	0.2	4
19	Jul.21	GL-114.7	Laurel Creek sampled where it reappears from under Waterloo Square & King St. S.	2,000	890,000	5.0	20		0.39			1.3			-
	Oct.17			970	15,000	12	5	.05	1.1	.007	< .01	.14	.003	0.2	-
20	Jul.21	GL-114.6 W	Outfall appr. 12"Ø corrugated steel into Laurel Creek at the S.E. corner of Regina St. bridge	160	2,300	-	-		-			-			-
21	Jul.21	GL-114.6 W	Outfall appr. 48"Ø encased concrete into Laurel Creek at bend in Herbert St. near Regina St.	10	6,500	3.0	190		1.5			0.57			2
	Oct.17			2,300	1,270,000	80	15	< .01	1.3	.003	.01	.21	.15	0.8	-

TABLE 1 - CONT'D

LAUREL CREEK - WATER POLLUTION SURVEY 1971 & 1973

Samples June, July 1971
October 1973

No.	Date	Sampling Point	Description of Location	Fecal Coliforms Per 100 ML	Coliform Bacteria Per 100 ML	5 Day B.O.D.	Susp. Solids	Nitrogen as N				Phosphorus as P		MBAS as LAS	Phenols in ppb
								Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.		
22	Jul.21	GL-114.5 W	Outfall appr. 72"Ø corrugated steel to Laurel Creek east of railway bridge appr. 350' south of Erb St. E.	10	3,100	2.5	10		0.5			0.06			-
	Oct.17			380	1,550	0.6	0	.08	0.09	.007	.20	.005	.003	< 0.1	-
23	Jul.21	GL-114.4	Laurel Creek sampled appr. 300' downstream of the bridge on Erb St. E.	2,000	320,000	3.5	20		1.0			0.26			-
	Oct.17			240	61,500	3.5	10	.11	1.1	.015	.25	.094	.009	0.1	-
24	Jun.24	GL-114.2 W	Outfall to Laurel Creek Behind City Works Dept. Yard	170	4,400	2.0	5		0.28			0.038			-
	Oct.17			330	61,500	0.8	0	.02	.30	.009	8.8	.047	.044	< 0.1	-
25	Jun.24	GL-114.1	Laurel Creek sampled appr. 200' west of Brighton St.	L-10	110	3.0	10		0.88			0.062			-
26	Jun.24	GL-114.1 W	Outfall to Laurel Creek north side of creek at the end of Brighton St.	L-10	370	3.0	5		0.24			0.006			-
	Oct.17			L-10	740	0.6	0	.01	.14	.007	12.	.002	.001	-	-
27	Jun.24	GL-114.1 W	Outfall appr. 26"Ø concrete to Laurel Creek at N.W. corner of shopping plaza across from end of Brighton St.	L-10	500,000	110	30		2.0			1.4			4,000
	Jul.21			L-10	4,000	6.5	10		7.0			1.8			100
	Oct.17			L-100	160,000	10	5	.30	1.2	.010	.04	.12	.013	-	20
28	Jun.24	GL-114.0 W	Outfall to Laurel Creek appr. 600' west of Weber St. behind shopping plaza	L-10	350	1.6	5		0.87			0.04			-
	Oct.17			L-10	150	2.0	0	.28	.64	.049	.93	.026	.018	-	-
29	Jun.24	GL-113.9 W	Outfall to Laurel Creek appr. 350' W. of Weber St. behind shopping plaza	7,000	33,000,000	1.6	10		0.37			0.11			-
	Oct.17			50	61,500	2.5	0	.01	.14	.004	1.4	.28	.028	-	-

TABLE 1 - CONT'D

Samples - June, July 1971
October 1973

LAUREL CREEK - WATER POLLUTION SURVEY 1971 & 1973

No.	Date	Sampling Point	Description of Location	Fecal Coliforms Per 100 ML	Coliform Bacteria Per 100 ML	5 Day B.O.D.	Susp. Solids	Nitrogen as N				Phosphorus as P		MBAS as LAS	Phenols in ppb
								Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.		
30	Jun.24	GL-113.9	Laurel Creek sampled appr. 100' west of Weber St. and bridge	1,110	6,400	4.0	10		0.86			0.07			-
	Oct.17			30	61,500	3.5	5	.04	1.0	.012	.25	.067	.007	-	-
31	Jun.24	GL-113.9	Outfall appr. 60"Ø encased corrugated steel to Laurel Creek at S.E. cor. of bridge at Weber St.	720,000	7,600,000	30	30		2.0			55.0			-
	Jul.21	W		L-100	L-100	44	360		3.4			3.0			8
32	Jul.21	GL-113.8	Laurel Creek sampled appr. 300' east of bridge at Weber St.	L-10	280	22	290		1.6			1.2			4
33	Jul.21	GL-113.7	Outfall appr. 12"Ø encased concrete to Laurel Creek on south bank behind swimming pool in Moses Springer Park	L-10	1,400	0.4	5		0.2			0.007			-
	Oct.17	W		L-10	400	1.2	0	.05	.20	.013	7.6	.039	.019	-	-
34	Jul.21	GL-113.6	Outfall appr. 4"Ø asbestos to Laurel Creek appr. 600' south of Marshall St. in Moses Springer Park	L-10	150	0.4	5		0.18			0.003			-
	Oct.17	W		L-10	370	0.8	0	<.01	.21	.003	8.5	.010	.010	-	-
35	Jul.21	GL-113.5	Outfall appr. 16"Ø concrete to Laurel Cr. underneath Marshall St. bridge and on the east side	50	73,000	18	10		1.4			0.045			-
		W													
36	Jul.21	GL-113.5	Laurel Creek sampled appr. 100' downstream of Marshall St. bridge	540	13,000	4.5	25		0.98			0.16			-
	Oct.17			20	61,500	3.5	5	.01	.75	.010	.48	.047	.005	0.1	-
36A	Oct.17		Laurel Downstream of S.T.P.	50	61,500	3.5	10	.01	0.66	.009	.33	0.047	.005	0.1	5
36B	Oct.17		Trib. Laurel Cr. at University Ave.	L-10	570	1.2	10	.16	0.32	0.027	5.3	0.022	.005	-	

TABLE 1 - CONT'D

Samples - June, July 1971
October 1973

LAUREL CREEK - WATER POLLUTION SURVEY 1971 & 1973

No.	Date	Sampling Point	Description of Location	Fecal Coliforms Per 100 ML	Coliform Bacteria Per 100 ML	5 Day B.O.D.	Susp. Solids	Nitrogen as N				Phosphorus as P		MBAS as LAS	Phenols in ppb
								Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.		
37	Jun.24	GL-110.7	Laurel Creek sampled appr. 100' upstream of Mill St.	440	6,800	4.0	5		0.97			0.26			
	Oct.17		Dam ruins	130	61,500	2.5	0	0.01	.84	.008	.57	.046	.004	0.1	
38	Jun.24	GL-110.6 D	Ditch to Laurel Creek appr. 600' west of Bridge St. on south bank	100,000	4,200,000	300	-		90.0			18.0			-
39	Jun.24	GL-110.5	Laurel Creek sampled appr. 50' west of Bridge St.	260	3,600	3.5	5		0.93			0.29			-
40	Jun.24	GL-110.5 W	Outfall to Laurel Creek at N.W. corner of bridge	3,000	250,000	6.0	5		3.6			0.64			-
	Oct.17		at Bridge St.	61,500	61,500	9.0	0	3.3	3.5	.35	5.4	.60	.48	-	
41	Jun.24	GL-110-4 D	Undetermined discharge from sand into Laurel Cr. appr. 100' east of bridge at Bridge St. below the Grand Hotel Parking Lot	1,400	8,000	240	510		8.8			14.0			-
42	Jun.24	GL-110.4 W	Outfall to Laurel Creek appr. 250' east of bridge	4,000,000	13,000,000	280	-		58.0			12.0			-
	Oct.17		at Bridge St. below Grand Hotel Parking Lot	12,000	615,000,000	100	0	12.	20.	.012	.03	13.	11.	5.8	
43	Jun.24	GL-110.3	Laurel Creek sampled appr. 200' upstream of the confluence with the Grand River at Lancaster St. bridge	4,900	10,200	6.5	10		1.1			0.33			-
	Oct.17			100	61,500	1.2	0	0.8	.34	.019	2.0	.009	.005	0.1	
44	Oct.17		Tributary at Springvale Ave.	40	540	3.5	0	0.3	.84	.010	.43	.068	.012	-	

NOTE: All chemical analysis except Phenols reported in ppm.

LAUREL CREEK - SUMMARY 5 SAMPLE RUNS
1972 - W.Q.S.S.

TABLE II

Location	Fecal Coliforms Per 100 ML	Coliform Bacteria Per 100 ML	5 Day B.O.D.	Susp. Solids	Nitrogen as N				Phosphorus as P	
					Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.
Laurel Cr. Regional Rd. 54	33	146	1.4	10	0.11	0.66	0.013	1.04	0.052	0.014
Trib. at Water St.	13273	456	2.2	20	0.07	0.68	0.017	2.34	0.064	0.018
Inlet Laurel Cr. Reservoir	51	249	1.8	11	0.07	0.61	0.014	1.64	0.035	0.014
Outlet Laurel Cr. Reservoir	42	258	1.6	20	0.13	0.91	0.015	2.38	0.065	0.008
Laurel Cr. at Columbia St.	91	299	2.5	17	0.14	0.84	0.014	2.50	0.044	0.009
Laurel Cr. at Westmount Rd.	88	400	1.8	60	0.09	0.83	0.023	2.48	0.063	0.007
Clair Cr. at Westmount Rd.	107	475	3.3	100	0.10	1.21	0.031	1.35	0.166	0.015
Inlet to Silver Lake	158	1,218	2.1	23	0.14	0.88	0.023	1.67	0.057	0.012
Outlet of Silver Lake	167	963	2.6	28	0.11	0.81	0.023	1.66	0.057	0.011
Laurel Cr. at King St.	278	1,760	2.9	25	0.11	0.81	0.023	1.64	0.057	0.011
Laurel Cr. at Bridge- port Rd.	387	3,400	2.5	30	0.13	0.87	0.023	1.70	0.068	0.013
Laurel Cr. at Weber St.	243	2,400	2.4	40	0.11	0.87	0.023	1.68	0.066	0.015
Laurel Cr. at Univer- sity Ave.	124	562	2.5	35	0.08	0.66	0.022	2.52	0.07	0.011
Forwell Cr.	148	1,722	1.8	60	0.03	0.50	0.020	2.68	0.057	0.013
Laurel Creek at S.T.P.	166	274	2.1	126	0.37	0.89	0.036	2.8	0.179	0.049
Laurel Cr. Downstream S.T.P.	517	3,810	2.8	70	0.13	0.97	0.027	1.83	0.089	0.015

LAUREL CREEK - SUMMARY 5 SAMPLE RUNS
1972 - W.Q.S.S.

Location	Fecal Coliforms Per 100 ML	Coliform Bacteria Per 100 ML	5 Day B.O.D.	Susp. Solids	Nitrogen as N				Phosphorus as P	
					Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Tot.	Sol.
Trib. Downstream of S.T.P.	23	119	1.7	18	0.22	0.57	0.025	4.14	0.038	0.014
Laurel Cr. at Mill St.			22	30	2.55	6.25	2.355	1.60	1.300	0.540
Laurel Cr. at Bridge St.	160	690								
M.O.E. Monitoring 1972 Sta. at Mouth	617	4,634	2.2		0.18	0.99	0.059	1.527	0.101	0.019
Laurel Creek 1973	1,888	15,450	2.4		0.21	1.04	0.042	1.866	0.128	0.021

TABLE III

LAUREL CREEK - WATER POLLUTION SURVEY - 1971 - 1973SUMMARY OF OUTFALL EFFLUENTS

No.	Sampling Point	Location of Outfall	Description of Discharge
3	GL-117.4 W	Southeast end of University of Waterloo Village Residence I	Domestic wastes
4	GL-116.8	Across from the U. of Waterloo Campus Centre	Silica Carbonate Calcium Carbonate Magnesium Carbonate Aluminum Oxide
7	GL-116.4 W	East of Westmount Rd. bridge	Domestic wastes
9	GL-116.2 W	Below Centennial Park Dam	Domestic wastes
10	GL-115.8 W	Beside footpath into Centennial Park	Domestic wastes
14	GL-115.2 W	Below Silver Lake Dam at arena entrance	Domestic wastes
17	GL-115.1 W	Between railway bridges below arena	Domestic wastes Phenols
20	GL-114.6 W	Southeast corner of Regina St. bridge	Domestic wastes
21	GL-114.6 W	At the bend in Herbert St. near Regina St.	Domestic wastes Phenols Iron Oxide Chromium
22	GL-114.5 W	350 feet south of Erb St. East	Domestic wastes
24	GL-114.2 W	Behind City Works Dept. Yard	Domestic wastes
27	GL-114.1 W	Northwest corner of Tower's Shopping Plaza	Domestic wastes Phenols
29	GL-113.9 W	350 feet west of Weber St. behind Shopping Plaza	Domestic wastes

TABLE III CONT'D

LAUREL CREEK - WATER POLLUTION SURVEY - 1971 - 1973

SUMMARY OF OUTFALL EFFLUENTS

No.	Sampling Point	Location of Outfall	Description of Discharge
31	GL-113.9 W	Southeast corner of the bridge at Weber Street	Domestic wastes Phenols Aluminum Silicate
35	GL-113.5 W	Underneath the Marshall St. bridge and on the east side	Domestic wastes
40	GL-110.5	Northwest corner of bridge at Bridge St.	Domestic wastes
42	GL-110.4	Below the Grand Hotel Parking Lot	Domestic wastes

APPENDIX

II

APPENDIX II

SIGNIFICANCE OF LABORATORY RESULTS, ABBREVIATIONS AND SYMBOLS

A) BACTERIOLOGICAL EXAMINATION

TOTAL COLIFORM ORGANISMS include a wide variety of bacteria ranging from the genus (Group), *Escherichia Coli*, which originate mainly in the intestines of man and other warm-blooded animals, to the genera *Citrobacter* and *Enterobacter aerogenes*. The latter genera are basically found in soil but are also present in feces in small numbers.

The presence of total coliforms in water may indicate soil runoff or more important, less recent fecal pollution since organisms of the *Enterobacter* - *Citrobacter* groups tend to survive longer in water than do members of the *Escherichia Coli* group, and even to multiply when suitable environmental conditions exist.

The FECAL COLIFORM ORGANISMS are those coliform bacteria which are all intestinal origin and usually outnumber all other coliform types in human and animal intestines. Most of the coliform bacteria found by the fecal coliform test are of the genus *Escherichia Coli*. However, their death rate outside the warm body is the greatest and accordingly if the coliform present in the water are primarily fecal coliforms and their number is high, the pollution is probably nearby and recent. Smaller numbers but a high portion of fecal coliforms may indicate nearby pollution with counts reduced by dilution.

The results of the examinations are reported as "MF Coliform Count per 100 ml".

The Ministry's Guidelines and Criteria for Water Quality Management in Ontario (November 1972) indicate that water used for total body contact recreational can be considered impaired when the total coliform and/or fecal coliform geometric mean density exceeds 1000 and/or 100 per 100 ml respectively.

Note: the term "geometric mean" refers to a type of average; mathematically speaking, the geometric mean of a set of N numbers is the nth root of the product of the numbers; in practice, it is computed by the use of logarithms.

B) CHEMICAL ANALYSES

Biochemical Oxygen Demand

Biochemical Oxygen Demand (BOD) is reported in parts per million (ppm) and is an indication of the amount of oxygen required for the stabilization of the decomposable organic matter in water. The completion of the laboratory tests requires 5 days under the controlled incubation temperature of 20°C.

Biochemical oxygen demand directly affects the dissolved oxygen level within the watercourse, subsequently it must be limited in order to maintain dissolved oxygen levels in the receiving water to sustain the local aquatic life.

For warm water biota dissolved oxygen concentration should be above 5 mg/l at all times except in certain situations

concentrations may range between 5 and 4 mg/l for short intervals within any 24 hour period provided that water quality is favourable in all other respects.

For cold water biota, dissolved oxygen levels should not be below 6 mg/l except in spawning areas where dissolved oxygen levels must not be below 7 mg/l at any time. In certain situations, dissolved oxygen levels may range between 6 and 5 mg/l for short intervals within any 24 hour period provided that water quality is favourable in all other respects.

Solids

The value for solids expressed in parts per million is the sum of the values for the suspended and dissolved matter in the water. The concentration of suspended solids is generally the most significant of the solids analysis with regard to service water quality. The effects of suspended solids in water are reflected in difficulties associated with water purification, decomposition in streams, and injury to the habitant of fish. Substances should not be added to watercourses that will adversely affect the aquatic biota or will create objectionable deposits on the bottom or shore of any body of water.

Total Kjeldahl Nitrogen

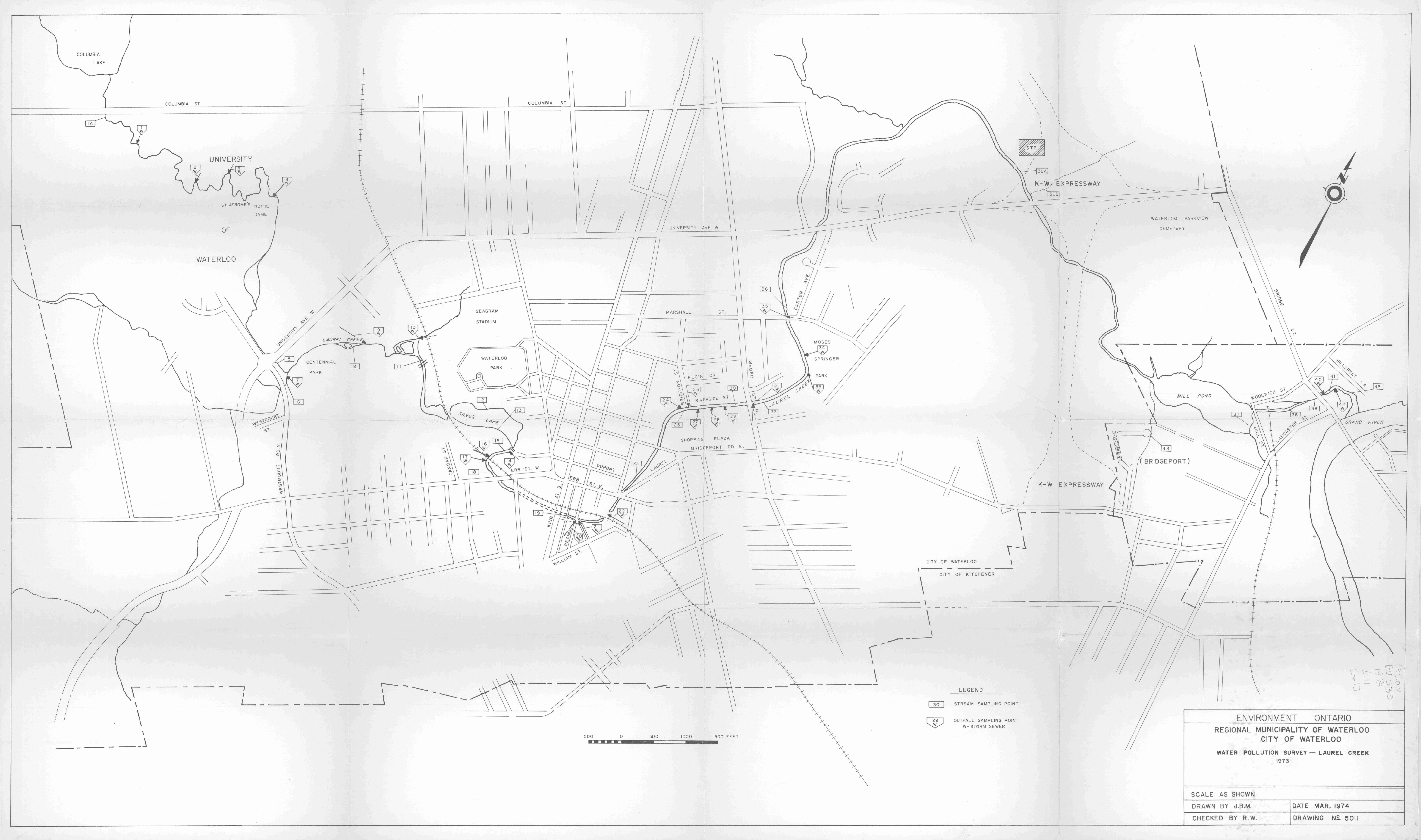
Total Kjeldahl is a measure of the total nitrogenous matter present except that measured as nitrite and nitrate nitrogens. The Total Kjeldahl, less the ammonia nitrogen measures the organic nitrogen present. Ammonia and organic nitrogen determinations are important in determining the availability of nitrogen for the biological utilization.

The normal range in surface waters for Total Kjeldahl would be 0.1 to 0.5 ppm.

Phosphorus

Phosphorus is a major element of municipal sewage as well as septic tank seepage as the result of the utilization of synthetic detergents. In addition, agricultural runoff contains often high amounts of phosphorus due to the fact that fertilizers, used on the land, dissolve and leach into the drainage system.

To a certain extent, phosphorus is a highly desirable element in maintaining a proper balance between plant and animal life in water. However, excessive and prolonged discharges will upset this balance and create an over-abundance of algae, weeds and nuisance organisms. Excessive growth of algae have been found developing in lakes when the average concentrations of inorganic phosphorus was over 0.01 ppm.





96936000009401